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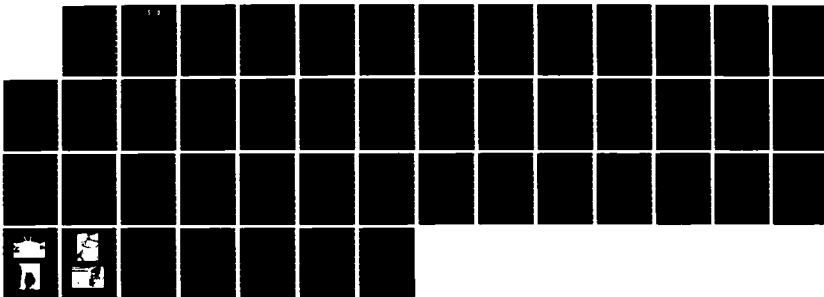
HOLY LOCH FLEET MOORING UNDERWATER INSPECTION REPORT  
(U) NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON DC  
CHESAPEAKE DIV JUN 84 CHES/NAVFAC-FPO-1-84(16)

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# HOLY LOCH FLEET MOORING UNDERWATER INSPECTION REPORT

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JUNE 1984

OCEAN ENGINEERING  
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CHESAPEAKE DIVISION  
NAVAL FACILITIES ENGINEERING COMMAND  
WASHINGTON, DC 20374

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AD-A168695

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION

Unclassified

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

3. DISTRIBUTION AVAILABILITY OF REP.  
Approved for public release;  
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2b. DECLASSIFICATION/DOWNGRADING SCHEDULE

4. PERFORMING ORGANIZATION REPORT NUMBER  
FPO-1-84(16)

5. MONITORING ORGANIZATION REPORT #

6a. NAME OF PERFORM. ORG. 6b. OFFICE SYM  
Ocean Engineering  
& Construction  
Project Office  
CHESNAVFACENGCOM

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and Zip Code)  
BLDG. 212, Washington Navy Yard  
Washington, D.C. 20374-2121

7b. ADDRESS (City, State, and Zip )

8a. NAME OF FUNDING ORG. 8b. OFFICE SYM

9. PROCUREMENT INSTRUMENT INDENT #

8c. ADDRESS (City, State & Zip)

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT #	PROJECT #	TASK #	WORK UNIT ACCESS #

11. TITLE (Including Security Classification)

Holy Loch Fleet Mooring Underwater Inspection Report

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT

13b. TIME COVERED  
FROM TO

14. DATE OF REP. (YYMMDD)  
84-06

15. PAGES  
43

16. SUPPLEMENTARY NOTATION

17. COSATI CODES  
FIELD GROUP SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if nec.)  
Fleet moorings, Underwater inspection,  
Mooring inspection, Holy Loch, Scotland

19. ABSTRACT (Continue on reverse if necessary & identify by block number)  
This report contains the results of the inspection of several fleet moorings  
located in Holy Loch, United Kingdom. A CHESNAVFACENGCOM-assigned Engineer-  
in-Charge and divers from Underwater Construction Team One conducted the  
inspection from 25 April - 05 May, 1984.

(Con't)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT  
SAME AS RPT.

21. ABSTRACT SECURITY CLASSIFICATION

22a. NAME OF RESPONSIBLE INDIVIDUAL  
Jacqueline B. Riley  
DD FORM 1473, 84MAR

22b. TELEPHONE 22c. OFFICE SYMBOL  
202-433-3881

SECURITY CLASSIFICATION OF THIS PAGE

**BLOCK 19 (Con't)**

The A-1, A-2, and AFDB-7 moorings were found to be in good condition and suitable for continued fleet use. However, the cause of the list in the A-2 bow buoy should be investigated at the earliest possible time. The YFNB-31 was found to be only in fair condition because of current mooring practices not considered in the initial mooring design. Specific comments concerning each of these moorings are included within this report.

# ABSTRACT

This report contains the results of the inspection of several fleet moorings located in Holy Loch, United Kingdom. A CHESNAVFACENGCOM-assigned Engineer-in-Charge and divers from Underwater Construction Team One conducted the inspection from 25 April - 05 May, 1984.

The A-1, A-2, and AFDB-7 moorings were found to be in good condition and suitable for continued fleet use. However, the cause of the list in the A-2 bow buoy should be investigated at the earliest possible time. The YFNB-31 was found to be only in fair condition because of current mooring practices not considered in the initial mooring design. Specific comments concerning each of these moorings are included within this report.

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## HOLY LOCH

### FLEET MOORING UNDERWATER INSPECTION REPORT

#### 1.0 INTRODUCTION

1.1 Background. Under the COMNAVFACEGCOM Fleet Mooring Maintenance (FMM) Program, CHESNAVFACEGCOM has been assigned the responsibility to plan and conduct periodic underwater inspections of fleet moorings worldwide. In carrying out this responsibility, CHESNAVFACEGCOM designated an Engineer-in-Charge to provide inspection planning, onsite technical direction, and support for the underwater inspection, by UCT ONE divers, of the A-1, A-2, and AFDB-7 moorings located in Holy Loch, United Kingdom (UK). The inspection was conducted 27 April - 5 May, 1984.

1.2 General Mooring History. Holy Loch is located on the west coast of Scotland about 30 miles west-northwest of Glasgow (see Figure 1). Access to Holy Loch from the Atlantic Ocean is via the Irish Sea and the Firth of Clyde. There are 10 moorings located in the northwest end of the Loch; Figure 2 shows the location of each of these moorings.

1.2.1 A-1 Mooring. The A-1 mooring was designed for use by the submarine tender (AS) class of vessel. This is a three-point mooring which consists of a bow buoy system and port and starboard quarter chain assemblies attached directly to the ship.

1.2.2 A-2 Mooring. This is a two-point bow/stern type mooring which consists of two buoy systems and was designed for use by one or more ships. Each of the two buoy systems comprising this mooring has four legs, three independent and one leg which is common to both systems.

1.2.3 AFDB-7 Mooring. This is a special floating drydock mooring consisting of four dock cells which are connected together and moored in place by 20 anchor chain subassemblies and anchors. The dock is 513 feet long and 241 feet wide. Each leg of three-inch-diameter chain runs from a padeye on deck to a 30,000-pound standard Navy stockless anchor with a stabilizer.



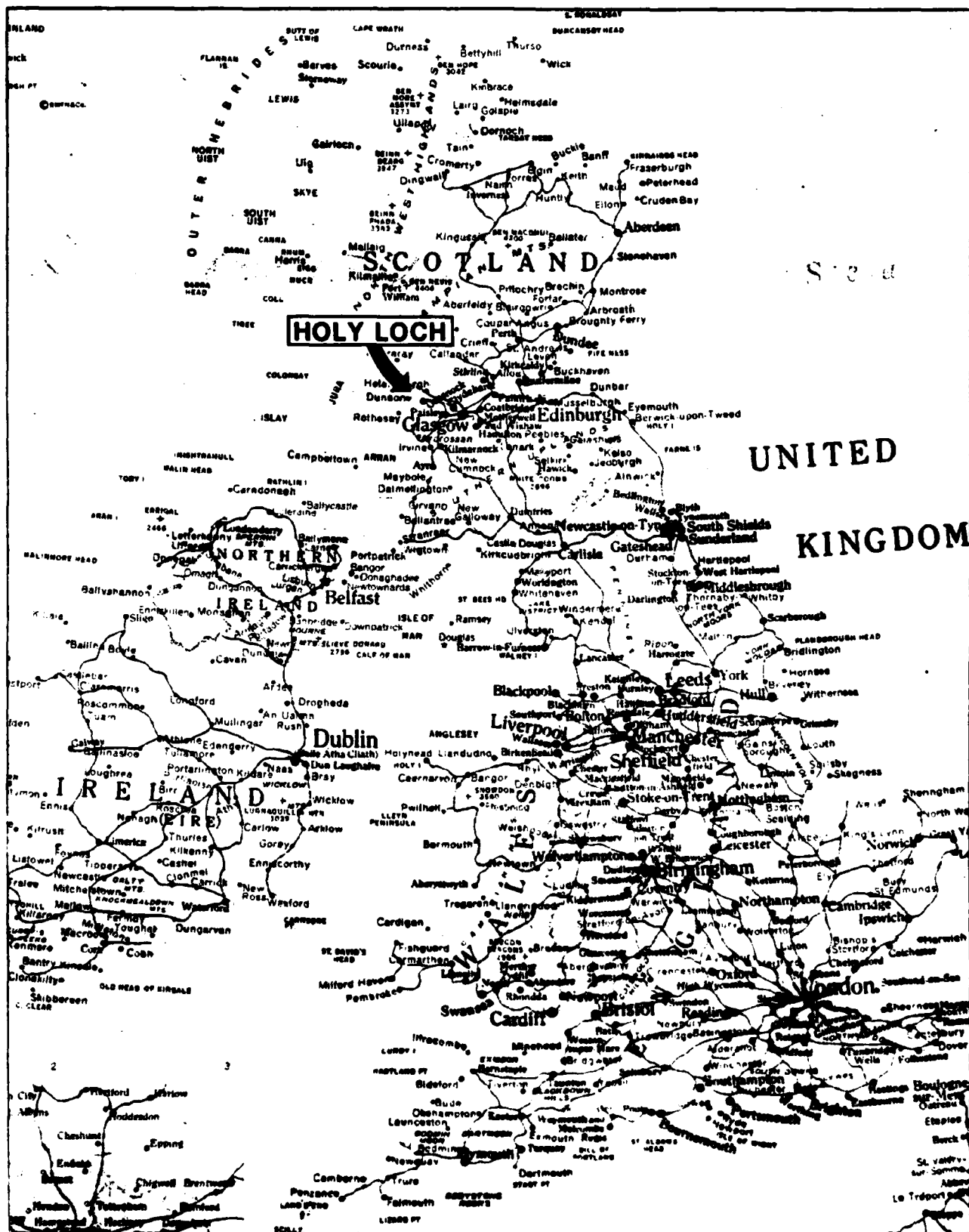


Figure 1. General Geographic Location of Holy Loch

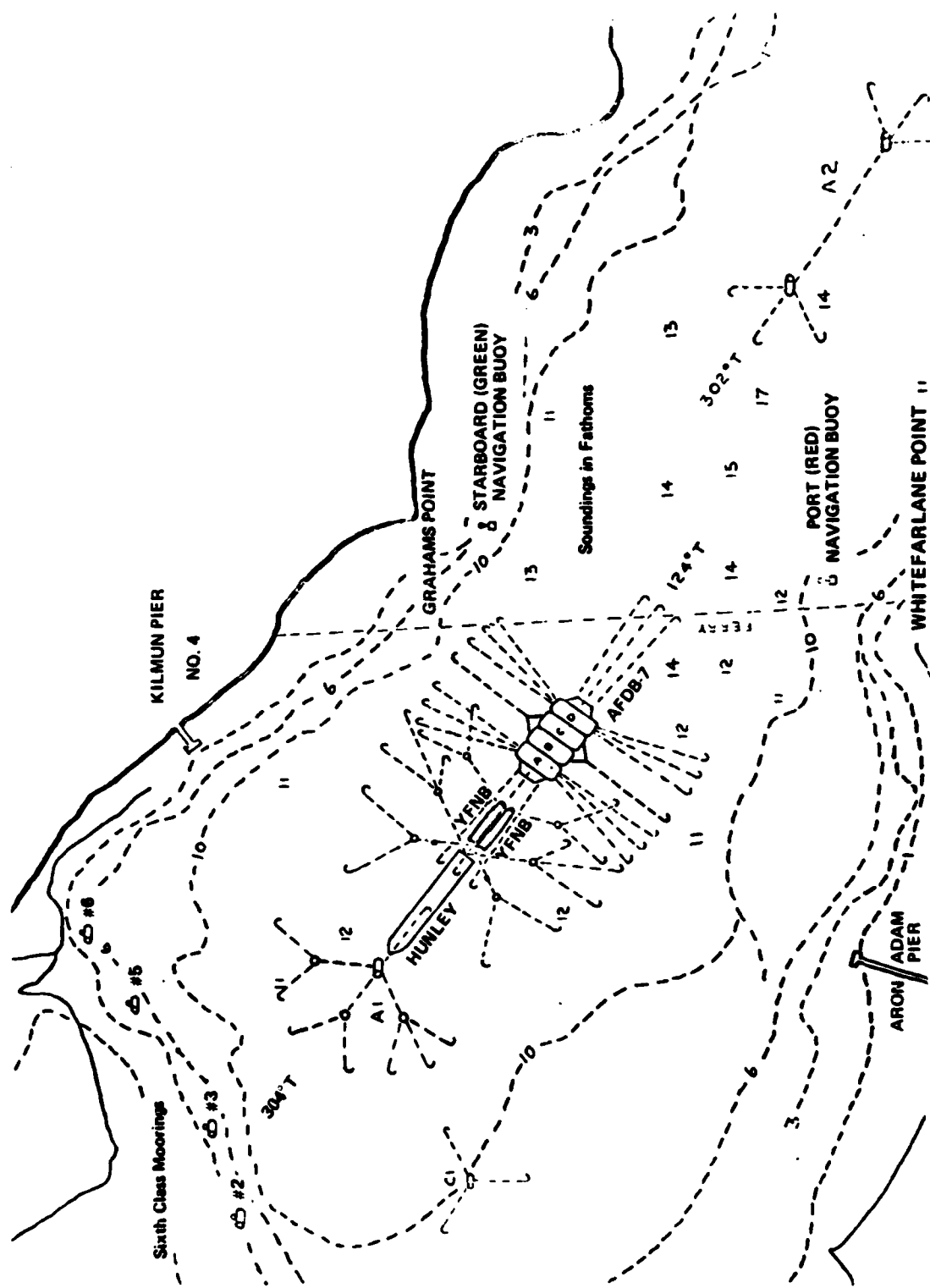


Figure 2. Holy Loch Moorings and Navigation Buoys

The drydock is routinely used by fleet ballistic missile (FBM) submarines. Because of the strategic importance of this facility and the prevalence of severe winter weather, the material condition of the mooring is a continuing concern. The ground legs were inspected by a CHESNAVFACENGCOM engineer and UCT-ONE divers in June of 1982. Over 70 percent of the ground legs were found to have measurements of less than 90 percent of their original wire diameter. As a result of this inspection, each of the 20 legs was removed in July of 1983, end for ended, and reinstalled.

## 2.0 INSPECTION PROCEDURES

2.1 Inspection Objectives. The purpose of the mooring inspections was to determine the general condition of the buoys and chain assemblies and to verify or update existing as-built and maintenance records. Divers inspected only a portion of the submerged buoy hulls and chain assemblies in order to compile a general description of the mooring's condition. The existence of fairly consistent measurements during this inspection provides a good indication of the mooring's overall condition. It should be kept in mind that periodic underwater inspections are intended as an expedient and relatively inexpensive supplement to accurate maintenance records. As such, they cannot fully substitute for a complete inspection involving recovery of the mooring and the measurement of each component.

Chain wire diameter measurements are used to evaluate the condition of a mooring. After the chain was cleaned to bare metal, a selective sampling of the wire diameter of chain links and connecting hardware was taken in order to determine the amount of deterioration due to corrosion and wear. "Single link" measurements were taken where the chain was slack to detect corrosion loss. "Double link" measurements were taken where two links connected under tension to detect the combined effects of corrosion and wear. Chain links and other components which measured 90 percent or greater of original wire diameter are considered to be in "good" condition; measurement between 80 and 90 percent of original diameter is considered "fair" condition and is cause for the mooring

to be downgraded in classification; any measurement less than 80 percent is considered "poor" and is cause for the mooring to be declared unsatisfactory for fleet use.

Standard underwater inspection procedures do not call for the inspection of any part of the mooring which has been buried or which is below a water depth of 130 feet if scuba gear is used. Ground legs and risers were observed only to the point at which they became buried; no attempt was made to locate and inspect anchors or other mooring materials which were not readily visible.

## 2.2 Buoys.

2.2.1 Buoy Topside. Each buoy was inspected to determine its general condition. The buoy markings were checked for conformance to those noted in applicable charts. Physical damage such as holes, dents, or listing was described. Hatches, openings, and penetrations were examined, and worn material and rust were reported.

The buoy chafing strips were checked for integrity and secure connection to the buoy. Buoy top jewelry was measured with calipers to find the overall outside dimensions and areas of most severe reduction in wire size.

2.2.2 Buoy Lower Portion. Divers inspected the buoy below the waterline. The thickness of marine growth was recorded, and the condition of the buoy bottom was noted.

2.3 Riser Subassembly. To determine chain wear, each riser chain was inspected by taking three consecutive double link measurements, at both ends and at the center of the riser, using precut gauges and/or calipers. To determine original chain size, divers took single link caliper measurements of the wire diameter and measured the length of each link inspected (length of a link equals six times the original wire diameter).

2.4 Ground Rings/Ground Legs/Sinkers and Anchors. Where visible, caliper measurements were taken of this material.

2.5 AFDB-7 Mooring. As part of the post-installation inspection, catenary angle measurements were taken in order to determine the effect of winter storms on the mooring. (A schematic drawing of the AFDB-7 mooring is shown in Figure 3.) Each of these measurements was corrected to reflect the same tide and freeboard conditions prevailing when similar measurements were taken after the mooring was overhauled in 1983. The parameters involved are shown in Figure 4. Inclinator measurements were taken where the chain enters the water. Depth readings were taken below the deck edge and at the point the chain enters the bottom. The lateral distance is the horizontal distance from the deck to a pop float tied to the chain at the point it enters the bottom.

In addition, a selective number of the 20 legs were checked for wear. All the legs were inspected for secure connecting links and swivels.

### 3.0 INSPECTION SUMMARY

An in-depth discussion of the inspection results is contained in Annex A. Annex B contains buoy location survey data; Annex C contains schematic drawings of British mooring hardware; Annex D contains onsite photographs; and Annex E contains a copy of the preliminary report of the results of the inspection. An evaluation of the information gathered during the inspection indicates the following:

3.1 A-1 Mooring. This is a three-point mooring consisting of a bow buoy system and port and starboard quarter chain assemblies. The bow buoy was installed in 1983 and is in good condition. All three chain subassemblies and visible portions of anchor chain subassemblies measured greater than 90 percent of their original wire diameter. No remedial action is required on this mooring and it is satisfactory for continued fleet use.

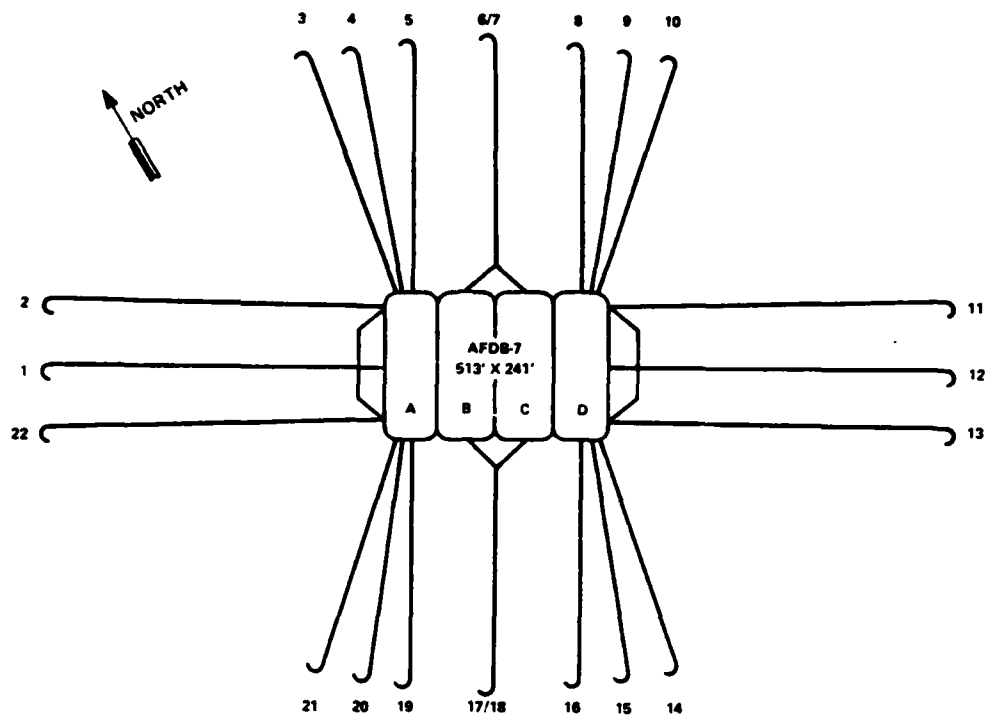
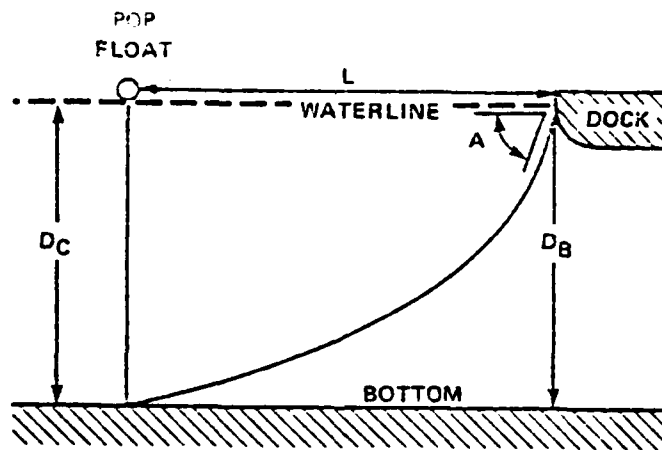


Figure 3. Schematic of AFDB-7 Mooring, Showing Ground Leg Numbers



Catenary Data

- L = Lateral Distance
- A = Inclinator Angle
- $D_C$  = Depth Where Chain Enters Mud
- $D_B$  = Depth Below Deck Edge

Figure 4. Catenary Parameters

3.2 A-2 Mooring. This mooring is a bow/stern mooring with one leg common to both buoy systems. The following findings were reported:

- o All chain measurements were greater than 90 percent of their original wire diameter.
- o The bow buoy ring shackle (see Annex C) has a 1/4-inch-deep groove worn into its inner surface.
- o It was noted that British and U.S. Navy chain and hardware are being used together. See Annex C.
- o The bow buoy has a slight list which may be due to a loss of water tight integrity. The cause of this list should be investigated at the earliest possible time.

Except for the questionable condition of the bow buoy, this mooring is in satisfactory condition for continued fleet use.

3.3 AFDB-7 Mooring. Catenaries for all anchor chain subassemblies were measured to be 2 to 8 degrees greater than the angles determined during installation. This indicates additional slack in the chain probably caused by some anchor drag and straightening of the chain installed on the bottom. Seven legs were shortened by removing six to nine links per leg to restore the catenaries of all legs to about 70 degrees. Each of the 20 anchor chain subassemblies inspected had a measurement greater than 90 percent of its original 3-inch wire diameter.

This mooring is in satisfactory condition for continued fleet use. It is recommended that catenary angles be rechecked in 1985 following the high winds normally encountered during winter storms.

3.4 YFNB-31 Mooring. The upper portion (ship to water surface) of this mooring was also inspected and the following discrepancies noted.

- o The tops of all closed mooring chocks aboard the YFNB have been cut away because the chain would not fit through the chocks. See Figure D-3. It is recommended that these chocks be replaced at the earliest practicable date.
- o The strain in the port bow mooring leg is now taken by a wire rope strap. It is recommended that the strain be taken off this strap and transferred to the pelican hook/mooring bitt.
- o Six spring-lay hawsers have been attached between the USS HUNLEY and the YFNB-31 to control the maximum separation of the vessels in an attempt to protect the brow crossing between these vessels. See Figure D-4. In easterly storms, forces transferred from the HUNLEY to the YFNB via these hawsers could result in overloading of the YFNB bow moorings, causing dragging of the YFNB bow anchors. It is recommended that this practice be discontinued, if at all feasible, to protect the YFNB bow moorings. If use of the hawsers is required, then the strengthening of the YFNB bow moorings by installing larger anchors is recommended.

3.5 Summary Table. Table 1 presents the current status of those Holy Loch moorings inspected.



Table 1. Inspection Summary

Mooring Number	Condition	Comments
A-1	Good	Buoy is in good condition. Riser chain subassemblies are covered with heavy (4 1/2") marine growth. All measurements greater than 90%.
A-2	Good*	Underwater hull and upper riser chain subassembly of each buoy is covered with heavy marine growth. The bow buoy has a slight list which may indicate water leakage. The bow buoy ring shackle has a 1/4-inch-deep groove worn in its inner diameter. All measurements greater than 90%.
AFDB-7	Good	All anchor chain subassemblies measured greater than 90 percent of original wire diameters. Catenaries of anchor chain subassemblies were 2 to 8 degrees greater than the angles measured during installation.  Seven legs were shortened to restore catenaries to about 70 degrees.
YFNB-31	Fair	Tops of all closed mooring chocks have been cut away. These should be replaced. The practice of using six spring-lay hawsers between the USS HUNLEY and the YFNB-31 should be reviewed.

\* The cause of the list in the bow buoy should be investigated at the earliest possible time.

## ANNEX A

### MOORING INSPECTION RESULTS

This annex contains for each mooring:

- o a summation of the inspection data obtained by the CHESNAVFACENGCOM EIC and the UCT ONE divers, and
- o a diver data reporting form.

A-1

CHESNAVFACENGCOM REPORT FPO-1-84(19), "HOLY LOCH FLEET MOORING UNDERWATER  
INSPECTION REPORT."

## INSPECTION RESULTS

### A-1 (Bow)

Buoy. This is a 6-foot 7-inch-diameter cylindrical buoy with a length of 14 3/4 feet. The buoy was installed in 1983 and, therefore, it has only a light coating of marine growth on its bottom. No damage was observed.

Riser Chain Subassembly. A 4-inch-diameter riser chain connects the buoy to the ground ring which is at a water depth of 70 feet (about 10 feet off the bottom). All measurements were greater than 90 percent of original wire diameter. Above a depth of 65 feet, the riser is covered with a heavy layer of marine growth.

Ground Ring. The ground ring has a wire diameter of 8 inches and is free of marine growth.

Anchor Chain Subassembly. Only three to five links of each leg were visible between the ground ring and the point where the chain enters the bottom. Each link is a British square link measuring 4 inches in wire diameter and 3 feet 10 inches in length (see Annex C). All measurements were greater than 90 percent of original wire diameter.

Conclusions/Recommendations. This buoy system is in satisfactory condition for continued fleet use.

### A-2

CHESNAVFACEGCOM REPORT FPO-1-84(19), "HOLY LOCH FLEET MOORING UNDERWATER INSPECTION REPORT."

MOORING NO.: A-1 (REV) CLASS: 1ST CLASS LOCATION: HOLY LOCH, D.K. LAT: 55° 59' 20" N LONG: 04° 56' 15" W

BUOY TYPE: CYLINDRICAL ANCHOR SIZE/TYPE: PORT CABLE WATER DEPTH: 80' VISIBILITY: 8'-10' BOTTOM TYPE: MUD

DATE: 5/3/84 ENGINEER-IN-CHARGE: D. RAECKE DIVERS: SWAN/JOHNSTON

COMPONENTS	GAUGE SIZE	CONDITION						COMMENTS
		LINK LENGTH	SINGLE LINK %		DOUBLE LINK %		DEPTH	
			90+	80+	80-	90+		
BUOY HARDWARE								6 1/2" WIRE DIAMETER (CALIPER)
BUOY RING SHARD			✓					4 1/4" WIRE DIAMETER, 10 1/2"
MOORING LINK		30"	✓					12" SIDE DIAMETER, GOOD CONDITION
MOORING LINK		30"	✓					
FIRST CLASS BUOY								LIGHT MARINE GROWTH, 6' 7" x 14' 9"
RISER	NEAR BUOY	4"				✓✓✓		HEAVY MARINE GROWTH ABOVE
	MIDDLE	4"				✓✓✓		65' CHAIN CLEAN BELOW THAT
	NEAR GRD RG	4"				✓✓✓		POINT.
GROUND RING		5"						70' 10' OFF BOTTOM
GROUND LEG NO. A	UPPER END							
	MIDDLE							
	ENTERS BOTTOM					WAY 3-5 LINKS OF EACH LEG		
GROUND LEG NO. B	UPPER END					VISIBLE ABOVE MUD LINE. LINKS		
	MIDDLE					ARE SQUARE CROSS SECTION		
	ENTERS BOTTOM					MOORING CHAIN (4" x 4" x 3' 10")		
GROUND LEG NO. C	UPPER END							
	MIDDLE							
	ENTERS BOTTOM							

FOR ADDITIONAL LEGS USE OTHER SHEETS SHEET 1 OF 1

## INSPECTION RESULTS

### A-1 (Port Quarter)

Buoy. None installed. The chain subassembly is attached directly to the submarine tender (AS).

Chain Subassembly. The chain is 3 inches in diameter with each link 18 inches in length. All measurements were greater than 90 percent of original wire diameter. The chain has a heavy layer of marine growth. The chain enters the bottom at a depth of 85 feet.

Conclusions. This section of the mooring is satisfactory for continued fleet use.

DATE: 5/4/84 ENGINEER-IN-CHARGE: D. RAECKE DIVERS: DEVAL/DANCHE

[illegible]

**SHEET 1 OF 1**

**CHESNAVFACENGCOM REPORT FPO-1-84(19), "HOLY LOCH FLEET MOORING UNDERWATER INSPECTION REPORT."**

## INSPECTION RESULTS

### A-1 (Starboard Quarter)

Buoy. None installed. The riser subassembly is attached directly to the Submarine Tender (AS).

Riser Chain Subassembly. The riser consists of 3-inch-diameter chain with each link 18 inches in length. All measurements were greater than 90 percent of original wire diameter. The chain has a heavy layer of marine growth.

Ground Ring. No ground ring was located. The riser chain enters the bottom at a depth of 86 feet.

Conclusions. This section of this mooring is in satisfactory condition for continued fleet use.

MOORING NO.: A-1 STD QTR CLASS: - LOCATION: HOLY LOCH, U.K. LAT: NA LONG: NA  
 BUOY TYPE: NONE ANCHOR SIZE/TYPE: NOT OBSERVED WATER DEPTH: 86' VISIBILITY: - BOTTOM TYPE: MUD  
 DATE: 5/4/84 ENGINEER-IN-CHARGE: D. RAECKE DIVERS: DIGERRE / WRIGHT

COMPONENTS		GAUGE SIZE	CONDITION								COMMENTS	
			LINK LENGTH	SINGLE LINK %		DOUBLE LINK %			DEPTH			
				90+	80+	80-	90+	80+		80-		
BUOY HARDWARE												THERE IS NO BUOY. HOORING CHAIN IS CONNECTED DIRECTLY TO THE SUB TENDER
RISER	NEAR BUOY	3"	18"				✓✓✓				5'	
	MIDDLE	3"	18"				✓✓✓				40'	
	NEAR GRD RG	3"	18"				✓✓✓				56'	RISER ENTERS BOTTOM
GROUND RING												NOT OBSERVED
GROUND LEG NO. A	UPPER END											NOT OBSERVED
	MIDDLE											
	ENTERS BOTTOM											
GROUND LEG NO. B	UPPER END											NOT OBSERVED
	MIDDLE											
	ENTERS BOTTOM											
GROUND LEG NO. C	UPPER END											NOT OBSERVED
	MIDDLE											
	ENTERS BOTTOM											

FOR ADDITIONAL LEGS USE OTHER SHEETS SHEET 1 OF 1



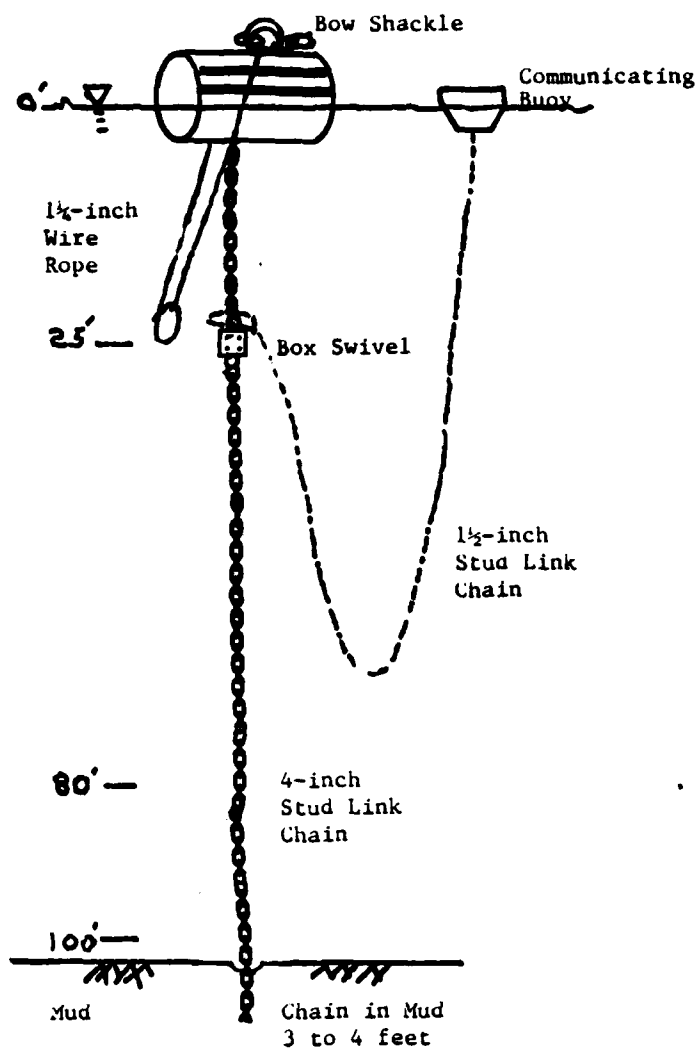
## INSPECTION RESULTS

### A-2 (Bow)

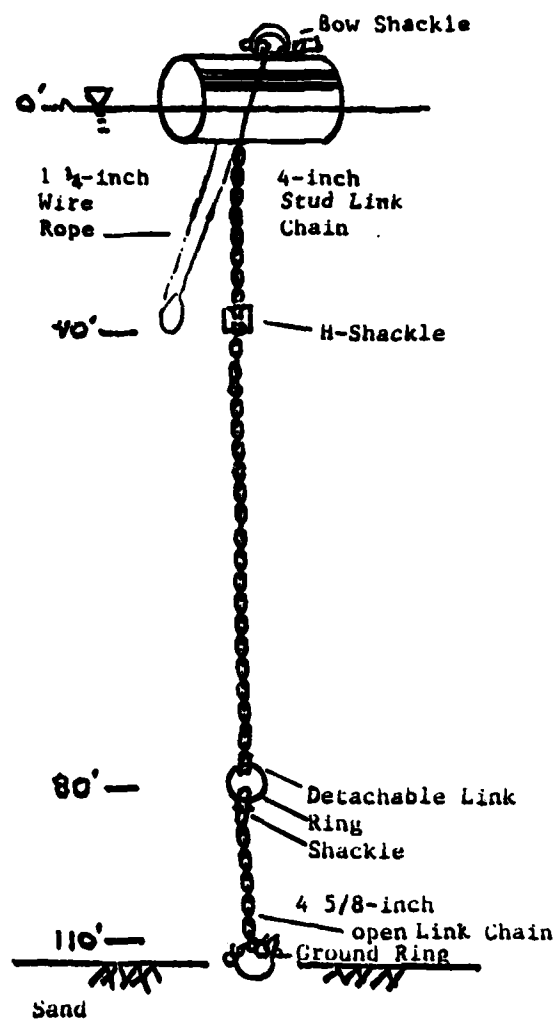
Buoy. This is a 6-foot 7-inch-diameter ("X" class) cylindrical buoy with a length of 14 3/4 feet. It has wooden fenders, and the upper hull is covered with rust. Below the water line the hull is covered with 4 1/2 inches of marine growth. The buoy has a slight list to starboard which may indicate loss of watertight integrity. A buoy shackle with a wire diameter of 6 1/2 inches is attached to the top link of the riser chain. The bow of this shackle has a 1/4-inch-deep groove worn in it by wire rope.

Riser Chain Subassembly. The riser consists of 4-inch-diameter chain with each link being 24 inches in length. The chain is covered with about 4 1/2 inches of marine growth from the surface to a depth of about 70 feet. Below this depth the chain is free of growth. A unique "box" swivel (see Annex C) was located in the riser at a depth of 25 feet. All measurements were greater than 90 percent of original wire diameter. The riser chain enters the bottom at a depth of 100 feet. The ground ring and anchor chain subassembly are buried in the bottom.

Comments and Recommendations. This buoy system (see Figure A-1) is in satisfactory condition for continued operational use. The buoy should be inspected to determine the cause of the list.



Bow Buoy System



Stern Buoy System

Figure A-1. Mooring A-2 Buoy Systems

MOORING NO.: A-2 (bow) CLASS: 1ST CLASS LOCATION: HOLY LOCH, UK LAT: 55°59'03"N LONG: 04°55'15"W  
 BUOY TYPE: CYLINDRICAL ANCHOR SIZE/TYPE: NO. 100 WATER DEPTH: 100' VISIBILITY: 6-10' BOTTOM TYPE: SILT OVER SAND  
 DATE: 5/1/84 ENGINEER-IN-CHARGE: D. RAECKE DIVERS: DONCHUE / WRIGHT

COMPONENTS	GAUGE SIZE	CONDITION							COMMENTS
		LINK LENGTH	SINGLE LINK %		DOUBLE LINK %			DEPTH	
			90+	80+	80-	90+	80+		
BUOY HARDWARE									6 1/2" WIRE DIAMETER (CALIPER)
		30"							4 1/4" WIRE DIAMETER. 10 1/2"
		30"							INSIDE DIAMETER
FIRST CLASS BUOY									6' 7" X 4' 9" 30" FREEBOARD, 10
RISER	NEAR BUOY	4"	24"						10'
	MIDDLE	4"	24"						50'
	NEAR GRD RG	4"	24"						100'
GROUND RING			BULIEN						RING SHACKLE. THREE-BOLTS
GROUND LEG NO. A	UPPER END		BULIEN						HOLD TIMBER IN PLACE, BUOY
	MIDDLE								HAS FOUR 20" X 16" HAPHALES --
	ENTERS BOTTOM								TWO ON EACH END. BUOY HAS
GROUND LEG NO. B	UPPER END		BULIEN						SLIGHT LIST. HEAVY (4 1/2")
	MIDDLE								GRASSY GROWTH AND BARBARIKLES
	ENTERS BOTTOM								ON BUOY BOTTOM AND RISER.
GROUND LEG NO. C	UPPER END		BULIEN						NO GROWTH BELOW 20'. A BEX
	MIDDLE								SUNBEL LOCATED AT 25'. LIGHT
	ENTERS BOTTOM								RUST ON BUOY.

FOR ADDITIONAL LEGS USE OTHER SHEETS

SHEET 1 OF 1

## INSPECTION RESULTS

### A-2 (Stern)

Buoy. This is a 6-foot-7-inch-diameter ("X" class) cylindrical buoy with a length of 14 3/4 feet. It has wooden fenders and the upper hull is covered with rust. Below the water line the hull is covered with 4 1/2 inches of marine growth.

Riser Chain Subassembly. The riser consists of 4-inch-diameter chain with each link being 24 inches long. All caliper measurements were greater than 90 percent of the original wire diameter. At a depth of 40 feet, the divers observed a unique "H"-shaped shackle with pins on each end of the H (see Annex C). No swivel was noted in the riser, and the ground ring was observed on the bottom (110 feet) beneath 10 to 15 chain links. At a depth of 80 feet, the riser contains a detachable link, a ground ring, and then a shackle attached to the lower section of riser chain which is 4 5/8-inch-diameter open links.

Comments/Recommendations. This buoy system (see Figure A-1) is in satisfactory condition for continued fleet use.

MOORING NO.: A-2 (STEEL) CLASS: 1ST CLASS LOCATION: HOLY LOCH, U.K. LAT: 55°58'53"N LONG: 04°55'05"W

BUOY TYPE: CYLINDRICAL ANCHOR SIZE/TYPE: NO. 5 VISIBLE WATER DEPTH: 110' VISIBILITY: 6'-10' BOTTOM TYPE: SANDY

DATE: 5/1/84 ENGINEER-IN-CHARGE: D. RAECKE DIVERS: SLOAN / JOHNSTON

COMPONENTS		GAUGE SIZE	CONDITION							COMMENTS	
			LINK LENGTH	SINGLE LINK %		DOUBLE LINK %			DEPTH		
				90+	80+	80-	90+	80+			80-
BUOY HARDWARE											6 1/2" WIRE DIAHETER (CALIPER)
NEERING LINK			30"								4 1/4" WIRE DIAHETER, 10 1/2"
NEERING LINK			30"								INSIDE DIAHETER.
3" BEEDIE SHACKLE OR ORLE				NEERING LINK							GOOD CONDITION
RISER	NEAR BUOY	A" 24"								10'	NO SWIVEL NOTED IN RISER.
	MIDDLE	4" 24"								50'	"H" SHAPED PLATE SHACKLE
	NEAR GRD RG	4 3/4"								105'	AT 40'
GROUND RING			ON BOTTOM	UPPER	DOWN	RISER	DOWN			115'	
GROUND LEG NO. A	UPPER END										AT 80', DETACH / RING / SHACKLE
	MIDDLE										TO A 4 3/8" OPEN LINK
	ENTERS BOTTOM										
GROUND LEG NO. B	UPPER END										
	MIDDLE										
	ENTERS BOTTOM										
GROUND LEG NO. C	UPPER END										
	MIDDLE										
	ENTERS BOTTOM										

SHEET 1 OF 1

CHESNAVACENGCOM REPORT FPO-1-84(19), "HOLY LOCH FLEET MOORING UNDERWATER INSPECTION REPORT."

## INSPECTION RESULTS

AFDB-7

Anchor Chain Subassembly. Each chain subassembly inspected had measurements greater than 90 percent of its original 3-inch wire diameter. The visible sections of the chain appear to be in good condition.

Catenary Profile. Several observations were made in order to determine the catenary of each leg. Table A-1 contains the catenary data obtained while Figure 4 lists the parameters considered. Catenary angles for all anchor chain subassemblies were measured to be 2 to 8 degrees greater than the angles determined in July 1983. This indicates additional slack in the chain probably caused by some anchor drag and straightening of chain installed on the bottom. Seven legs were shortened (see Table A-1) by removing six to nine links per leg to restore catenary angles to about 70 degrees.

Conclusions/Recommendations. The AFDB-7 mooring is in satisfactory condition for continued fleet use. Catenary angles should be rechecked in the spring of 1985 after the high winds normally encountered during winter storms.

A-13

Table A-1. Catenary Data  
(See Figure 4 for Parameters)

Leg Number	July 1983		May 1984		Water Depth (feet) at Deck Edge (DB)	Water Depth (feet) at Pop Float (DC)	Lateral Distance (L) (feet)	Links Removed
	Cat. Angle (degree) 12' Tide 5' Freeboard (A)	Cat. Angle (degree) 12' Tide 5' Freeboard (A)						
2	49	--	--	--	--	--	--	--
3	70	71.5	98	97	70'	--	--	
4	71	72.5	98	98	70'	--	--	
5	69	75	98	100	45'	--	--	
6	--	--	106	96	70'	--	--	
7	--	--	91	--	--	--	--	
8	71	66.5	85	85	65'	--	9	
9	70	71	85	83	50'	--	8	
10	70	68	83	85	70'	--	6	
11	47	--	82	85	140'	--	--	
13	47	--	83	84	140'	--	--	
14	68	69	83	78	20'*	--	--	
15	72	69.5	84	80	20'*	--	6	
16	68	73.5	84	80	30'*	--	--	
17	--	--	84	78	30-35'*	--	--	
18	--	--	76	--	--	--	--	
19	70	69.5	84	76	20'*	--	7	
20	71	69.5	84	80	25'*	--	7	
21	67	70	84	80	30'*	--	8	
22	49	--	82	80	--	--	--	

\*Wind setting dock 10 to 15 feet to port

## ANNEX B

### SURVEY OF HOLY LOCH

#### FLEET MOORINGS

The geographical survey of several of the fleet moorings located at Holy Loch was completed with the assistance of UCT ONE personnel. Figure B-1 shows the locations of benchmarks used during the survey.



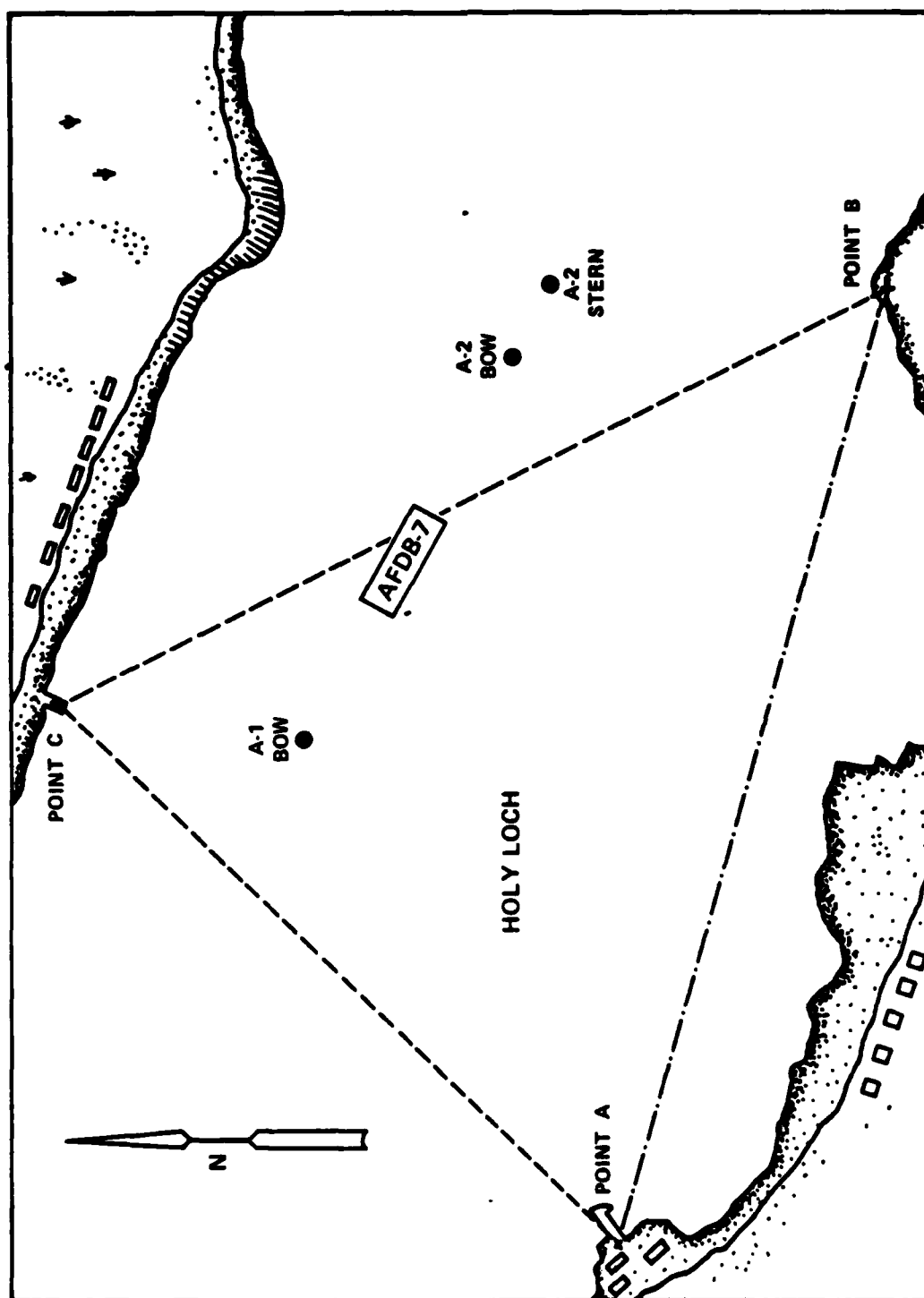


Figure B-1. Benchmark Locations

## BENCHMARK LOCATIONS

Robertson's Pier Station (Point A). Benchmark "A" is a steel angle driven into the ground, with a cross (+) chiseled into the top of the angle. Three steel pipes surround the angle, at approximately 120° spacing, to accommodate the transit legs. This benchmark is at the southeasterly corner of the landward end of the pier.

Robertson's Pier is a small boatyard approximately 3/4 of a mile west of the Ardnadam Hotel (NAVSUPPACTHQ) and the Admiralty Pier. The station is on private ground; permission from boatyard personnel (supervisor) is required to visit the station.

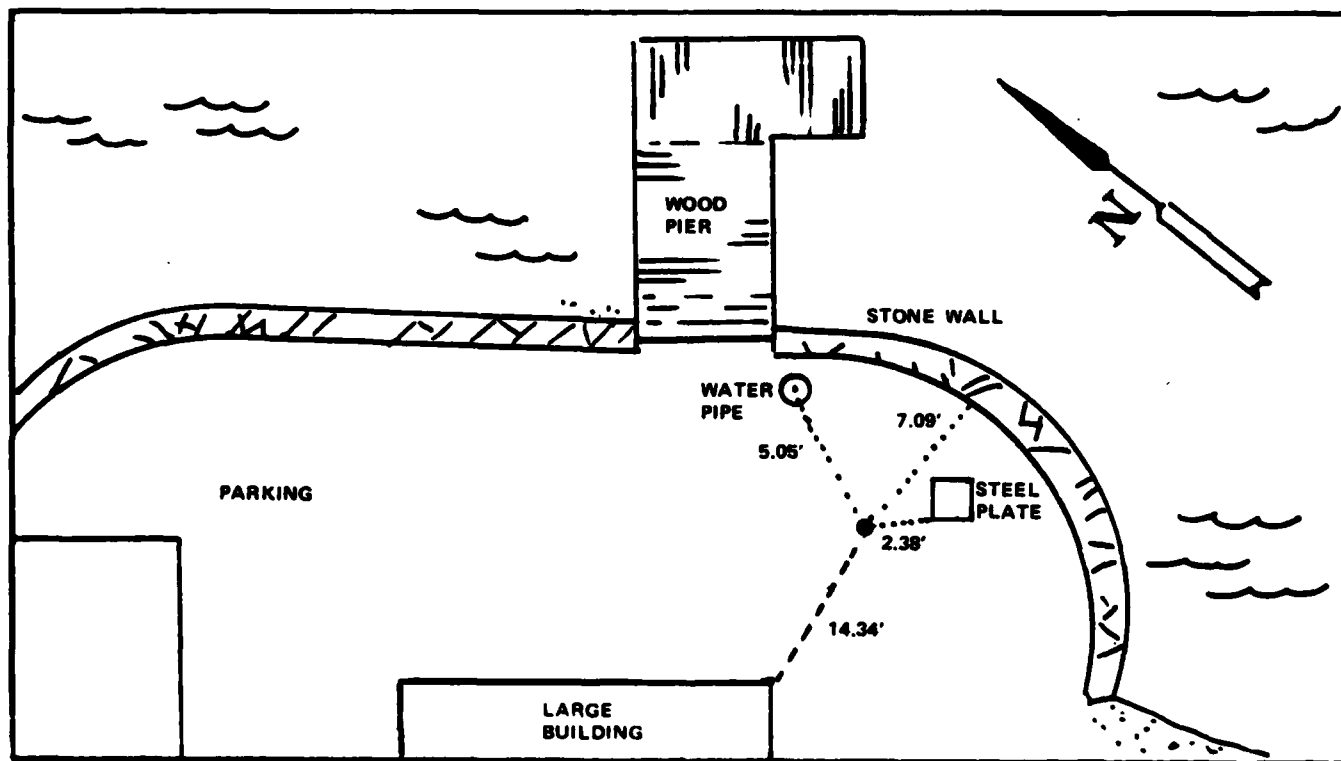


Figure B-2. Point A

Whitefarlane Point Station (Point B). This benchmark is a nail driven between two paving stones forming the base of the Whitefarlane Monument (WWI and WWII Memorial). The nail is 21 1/2 inches from the bottom edge of the monument (tapered circular stone pillar). The nail has blue, yellow, and red plastic flagging attached. Witness marks for the station consist of crosses chiseled on three paving stones at the outer edge of the monument base. See Figure B-3 for the location of the stones and crosses, and the measurements to the station. The station is on public ground with no access problems.

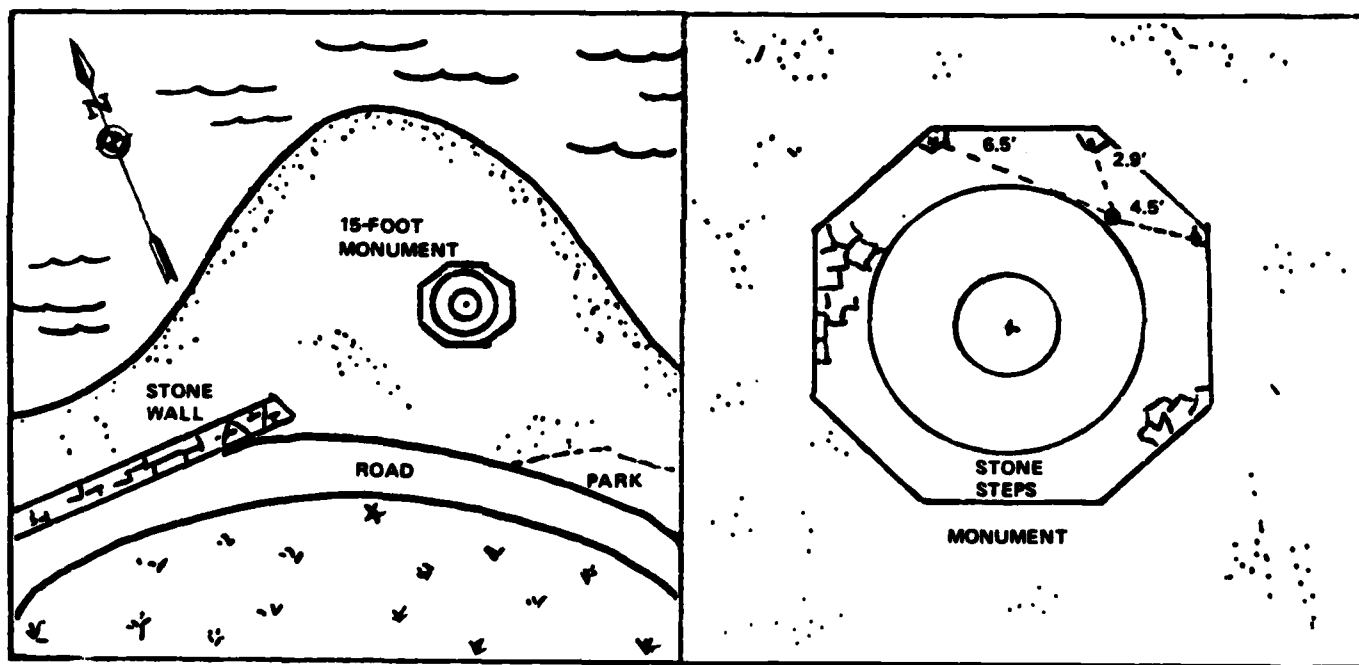


Figure B-3. Point B

Kilmun Pier Station (Point C). Benchmark "C" is a nail driven between two stones (through asphalt) on the deck of the concrete/masonry portion of the Kilmun Pier. See Figure B-4 for witness marks and the distances to the benchmark.

Kilmun Pier is located on the northern shore of Holy Loch (see Figure B-3), directly opposite the Kilmun Hotel. It is reached by taking the road through Sandbank and going around the periphery of the Loch. Turn right at the road sign to Kilmun at the head of the Loch. The station is on private ground, and permission to visit the station must be obtained from the Kilmun Post Office.

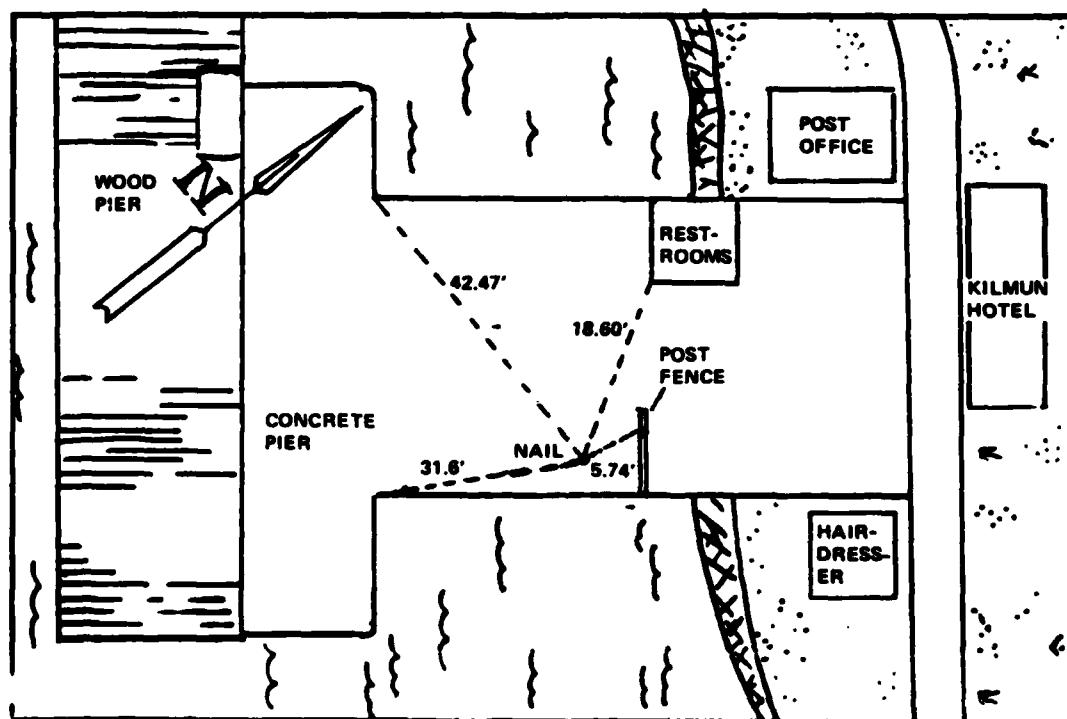


Figure B-4. Point C

# ANGLES BETWEEN SURVEY POINTS

ANGLE	ANGLE FROM POINT A BACKSIGHT TO POINT B	ANGLE FROM POINT B BACKSIGHT TO POINT A	ANGLE FROM POINT C BACKSIGHT TO POINT A
	COUNTERCLOCKWISE	CLOCKWISE	COUNTERCLOCKWISE
BAC	50°36'30"		
ACB			64°49'40"
ABC		64°37'20"	
CALC. FROM COORDINATES	50°37'30" (-1')	64°33'25" (+3'55")	64°49'05" (+35")

# SURVEY DATA SUMMARY

TARGET		ANGLE FROM POINT A BACKSIGHT TO POINT B	ANGLE FROM POINT B BACKSIGHT TO POINT A	ANGLE FROM POINT C BACKSIGHT TO POINT A
		COUNTERCLOCKWISE	CLOCKWISE	COUNTERCLOCKWISE
A-1 BOW BUOY	1	41°55'30"	42°57'20"	--
	2	41°57'00"	--	--
	3	41°53'00"	42°48'00"	15°09'40"
	Avg	41°55'10"	42°52'40"	15°09'40"
A-2 BOW BUOY	1	12°06'00"	139°14'20"	94°36'40"
	2	12°06'30"	139°13'00"	--
	Avg	12°06'15"	139°13'40"	94°36'40"
A-2 STERN BUOY	1	9°24'00"	154°31'20"	99°25'20"
	2	9°24'00"	154°30'00"	--
	Avg	9°24'00"	154°30'40"	99°25'20"
AFDB-7 PORT FWD CORNER	1	26°41'00"	53°37'20"	52°48'00"
	2	26°41'00"	--	--
	3	26°26'00"	53°21'20"	--
	4	26°40'00"	53°44'00"	--
	5	26°37'00"	53°35'40"	--
	Avg	26°37'00"	53°34'40"	52°48'00"
AFDB-7 PORT AFT CORNER	1	22°24'00"	61°04'40"	--
	2	22°27'00"	--	--
	3	22°06'30"	60°42'40"	--
	4	22°25'00"	61°13'20"	--
	5	22°21'00"	61°05'00"	--
	Avg	22°20'42"	61°01'24"	--
AFDB-7 STBD AFT CORNER		--	64°42'00"	64°57'20"

Notes: AFDB-7 Measurement Numbers 1 and 2 with Drydock partially flooded - 29" freeboard.

3 was made with drydock fully flooded.

4 and 5 were made with drydock fully deballasted.

# MOORING LOCATION SUMMARY

## CENTER OF AFDB-7

LAT	55°59'14"	N
LONG	4°55'57"	W

## A-1 BOW BUOY

LAT	55°59'20.5"	N
LONG	4°56'15.5"	W

## A-2 BOW BUOY

LAT	55°59'03"	N
LONG	4°55'15.5"	W

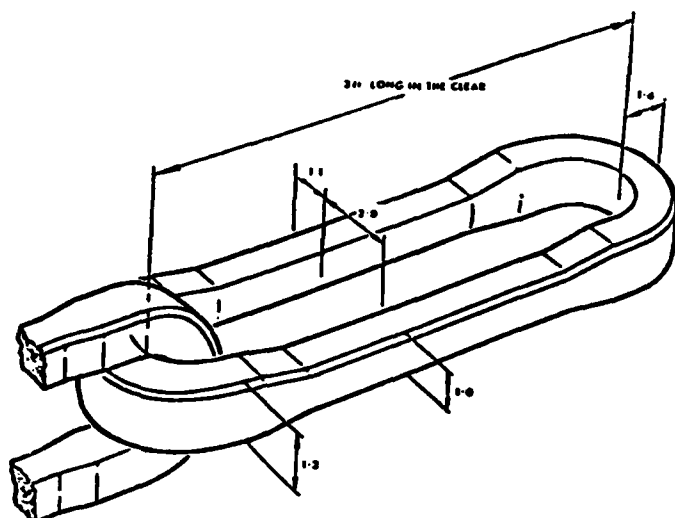
## A-2 STERN BUOY

LAT	55°58'59"	N
LONG	4°55'01"	W

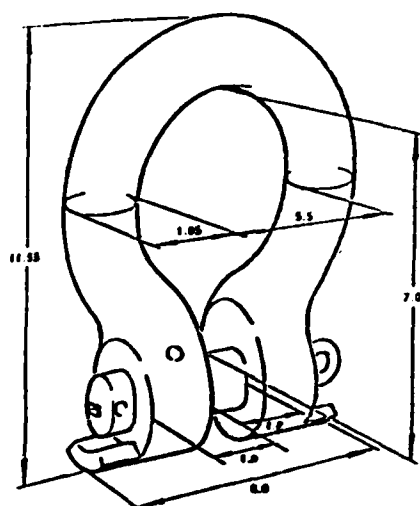
ANNEX C

BRITISH MOORING HARDWARE



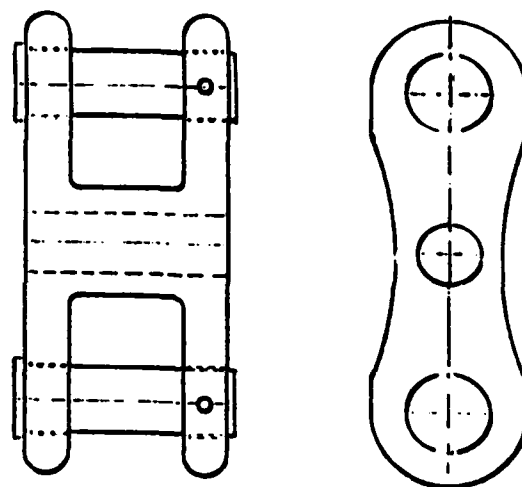


**ANCHOR CHAIN LINK**

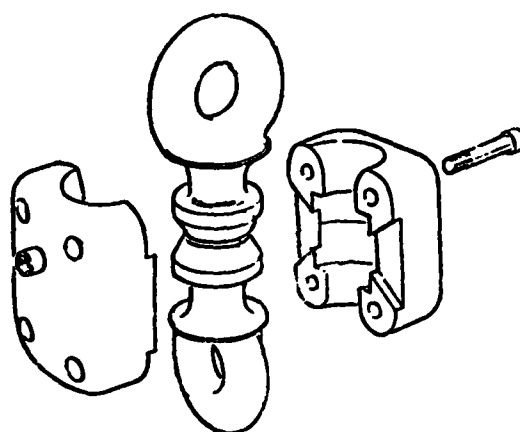


**BUOY RING SHACKLE**

Except where otherwise marked, the dimensions shown are multipliers of the size of mooring chain required for a mooring.



**"H"-SHAPED SHACKLE**



**BOX TYPE SWIVEL**

**BRITISH MOORING MATERIAL**

ANNEX D

PHOTOGRAPHS



D-1 A-1 Bow Buoy. Cylindrical Buoy in Good Condition



D-2 Special H-Shackle on Mooring A-2 (Stern Buoy)



D-3 Chain on YFNB-31 Bearing on Stanchion After Slipping from Chock



D-4 Use of Six Spring-lay Hawser Between USS HUNLEY and YFNB-31

ANNEX E

PRELIMINARY INSPECTION REPORT

UNCLASSIFIED

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FROM CHESNAVFACENGCOM WASHINGTON DC  
TO NAVSUPPACT HOLY LOCH UK  
INFO COMSUBRON FOURTEEN  
COMNAVFACENGCOM ALEXANDRIA VA  
USS LOS ALAMOS  
USS HUNLEY  
LANTNAVFACENGCOM NORFOLK VA  
UCT ONE  
MODUK NAVY LONDON UK  
NMSD FAIRLIE  
CINCUSNAVEUR LONDON UK

UNCLAS //N11000//

SUBJ: FLEET MOORING INSPECTION, HOLY LOCH, UK

1. A CHESDIV/UCT ONE UNDERWATER INSPECTION OF FLEET MOORINGS AT SITE ONE, HOLY LOCH, UK WAS CONDUCTED DURING THE PERIOD OF 19 APR - 8 MAY 84. THE FOLLOWING IS A PRELIMINARY REPORT OF THE INSPECTION RESULTS AS RELATED IN DEBRIEFINGS TO NAVSUPPACT (XO AND APWO), USS LOS ALAMOS (XO), COMSUBRON FOURTEEN (LT B. JOHNSON, ERP COORDINATOR), BY CHESNAVFACENGCOM.

UNCLAS

D. RAECKE

FP0-1C2

36608

6 JUN 84

H. S. STEVENSON, CDR, CEC, USN

COPY TO: 00/09...0161...DAILY

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2. THE FOLLOWING MOORINGS WERE INSPECTED AND FOUND TO BE IN GOOD CONDITION: USS LOS ALAMOS (AFDB-7) MOORINGS, A-1 BUOY AND USS HUNLEY PORT AND STARBOARD STERN QUARTER MOORINGS, AND A-2 BOW AND STERN BUOY MOORINGS. NO MAJOR DISCREPANCIES WERE FOUND THAT REQUIRE DOWNGRADING OR OVERHAUL OF ANY MOORINGS AT THIS TIME. MINOR DISCREPANCIES AND REMEDIAL ACTIONS ARE LISTED BELOW:

A. USS LOS ALAMOS: SURFACE CATENARY ANGLES FOR ALL MOORING CHAINS WERE 2 TO 8 DEGREES GREATER THAN ANGLES LEFT AT END OF OVERHAUL IN JUL 83. INCREASED ANGLES INDICATE SLACK IN CHAINS WITH GREATER ATHWARTSHIP MOTIONS DURING WINTER STORMS. LEGS 8, 9, 10, 15, 19, 20, AND 21 WERE SHORTENED BY REMOVING 6 TO 9 LINKS PER LEG TO RESTORE CATENARY ANGLES OF ALL CHAINS TO APPROX. 70 DEGREES. RECOMMEND SURFACE CATENARY ANGLES BE RECHECKED IN SPRING OF 85, FOLLOWING WINTER STORMS.

B. A-2 MOORING BUOYS: BOTH BUOYS ARE HEAVILY ENCRUSTED WITH MARINE GROWTH. A-2 BOW (WESTERLY) BUOY HAS SLIGHT LIST. RECOMMEND BUOYS BE INSPECTED DURING PROGRAMMED FY-85 MOD MAINTENANCE. CHANGE-OUT OF BUOYS IS RECOMMENDED AT THAT TIME.

C. YFNB-31: (1) TOPS OF ALL CLOSED MOORING CHOCKS HAVE BEEN

DISTR:

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UNCLASSIFIED NAME TITLE OFFICE SYMBOL PHONE

SIGNATURE

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CUT AWAY BECAUSE CHAIN WOULD NOT FIT THROUGH. RECOMMEND CHOCKS BE REPLACED AT EARLIEST PRACTICABLE DATE. (2) STRAIN IN PORT BOW MOORING LEG IS NOW TAKEN BY A WIRE ROPE STRAP. RECOMMEND STRAIN BE TAKEN OFF STRAP AND TRANSFERRED TO PELICAN HOOK/MOORING BITT.

(3) SIX SPRING-LAY HAWSERS HAVE BEEN ATTACHED BETWEEN USS HUNLEY AND YFNB-31 TO CONTROL MAXIMUM SEPARATION OF VESSELS IN AN ATTEMPT TO PROTECT BOW CROSSING BETWEEN VESSELS. IN EASTERLY STORMS, FORCES TRANSFERRED FROM HUNLEY TO YFNB VIA HAWSERS COULD RESULT IN OVERLOADING OF YFNB BOW MOORINGS CAUSING DRAGGING OF YFNB BOW ANCHORS. RECOMMEND DISCONTINUING THIS PRACTICE IF AT ALL FEASIBLE TO PROTECT YFNB BOW MOORINGS. IF USE OF HAWSERS IS REQUIRED THEN RECOMMEND STRENGTHENING YFNB BOW MOORINGS BY INSTALLING LARGER ANCHORS.

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DATE: 10/1/73

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